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Alternate Current Workings

BY DONALD H. FRY.

Part 1

ALTERNATING CURRENTS.

ALTERNATING currents are becoming more and more of interest to electricians, especially on the Pacific Coast where long distance transmissions are so prevalent for owing to the high voltages that can be attained and to the fact that it is possible to step up or step down to any required voltage, the alternating current is peculiarly adapted to long distance work. In fact, with possibly one exception in Switzerland, there are no long direct current transmissions. The object of the present series of articles is, therefore, to make clear some

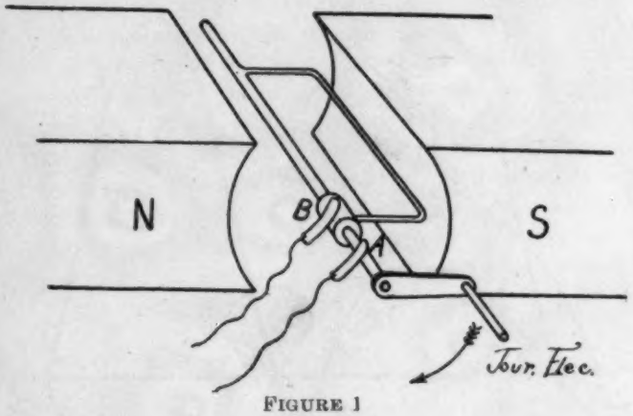


FIGURE 1

points in alternating currents not generally understood, avoiding mathematics as much as possible, and to briefly show wherein they fundamentally differ in nature from direct currents.

The alternating current is so called because it is continually undergoing a succession of rapid reversals. The electro-motive force rises and falls in periodic waves and thus causes the electricity or current to oscillate forward and backward with great rapidity. To illustrate how such a current is generated we will take the simplest form of an alternator,—a single wire revolving in a uniform magnetic field as shown in figure 1. One end of the wire is connected to the axis and the other to the metal sleeve B, insulated from the axis by a fibre brushing. The difference of potential between the sleeve B and some point on the axis A, is proportional to the rate at which the wire is cutting the magnetic lines of force crossing from N to S. When the loop is horizontal or parallel to the lines of force as shown in the figure, the rate of cutting is a maximum, but when the crank has been turned through 90 deg. and the plane of the loop is vertical, the wire will be traveling in the same direction as the lines

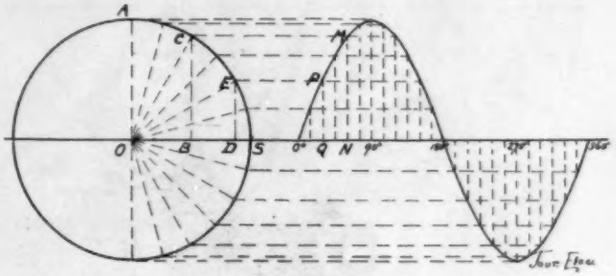


FIGURE 2

of force and the rate of cutting will be zero. An instant later the wire will have passed the zero point and be cutting the lines in the opposite direction and the potential between B and A will be negative—that is, B will be negative to A. When the crank has turned through half a revolution and the loop has reached a horizontal position again, the potential will be at a negative maximum; and so on through zero to a positive maximum in one complete revolution. If now we place rubbing contacts at A and B and connect them by a closed circuit, a current will flow from B to A and again from A to B during each revolution and we have an alternating current. The generation of direct currents is precisely the same with the addition of a commutator or rectifying device to keep the current flowing in one direction.

We have assumed the field to be uniform, and should the rate of rotation be kept constant, it is an easy matter

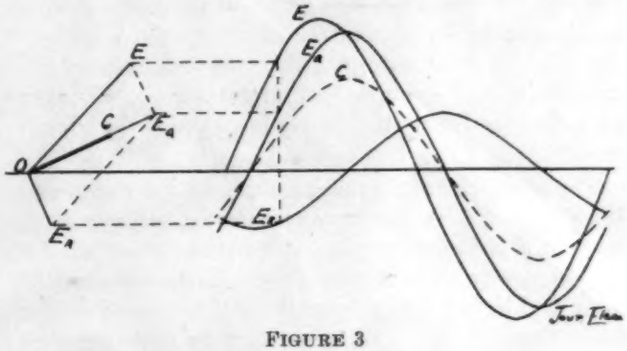


FIGURE 3

to derive a graphic representation of the relation between

time and electro-motive force, for by plotting the angles of the crank (which are proportional to time) on the horizontal, and the electro-motive force on the vertical (figure 2) we accomplish this and the curve the electro-motive force follows is a true sine curve. If OA, proportional to the maximum rate of cutting lines of force, be taken as unity, M N, equal to C B is proportional to the rate of cutting when the wire is in the position C, and C B is the sine of the angle S O C; likewise P Q = E D is the sine of the angle S O E, which shows whence the name sine curve is derived.

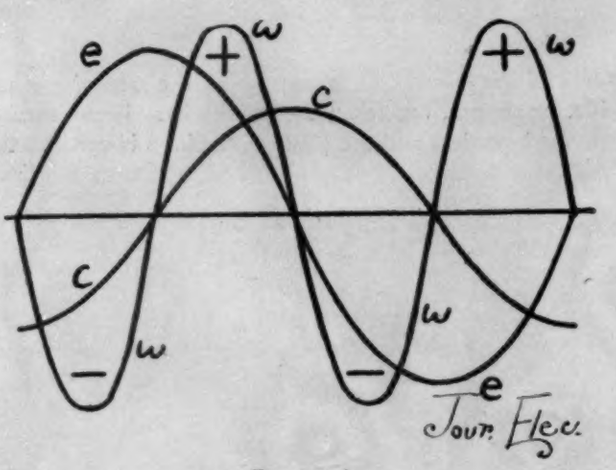


FIGURE 4

In practice the sine curve cannot be followed exactly owing to the fact that there are many wires in a coil instead of one, and it is impossible to procure a perfectly uniform field. However as a sine curve variation gives a minimum inductance it is desirable to follow it as closely as possible, especially in long transmissions where the induction of the line becomes an important item, and therefore most of the best modern machines approximate a sine curve very closely. This is accomplished by carefully proportioning the pole pieces, armature teeth and air gap. Also, since a motor should follow closely the same electro-motive force and current variations as the dynamo running it, the sine curve is resorted to as a standard, else to ensure high efficiency special motors would have to be designed for each generator.

The effective value of the electro-motive force is not the maximum, nor the average value, but the square root of the average square. In the case of the sine curve, taking O A, the maximum value, as unity, the average pressure is $2/\pi = .637$, but the effective value,—and it is the effective value only that concerns the practical electrician—is $\sqrt{\text{av. } e^2} = \frac{1}{\sqrt{2}} = .707$. Hereafter E will designate the effective electro-motive force and C the effective current.

The properties of alternating currents differ somewhat from those of direct, for they are affected not only by the resistance of the circuit, but also by its induction. Self-induction may be compared to the inertia of a moving body and in fact it is the inertia of the moving current, which tends to retard the current in its rapid reversals, and so causes it to lag somewhat behind its electro-motive force—or, in other words, to throw it out of phase. The alternating current sets up a counter electro-motive force, which is proportional to its rate of change; or in other words, again, this counter pressure is a retarding field caused by the current itself and though it has the same period as the current, it is out of unison with it and follows behind by an angle of 90 degrees, thus tending to hold the current back. As this counter pressure is in a measure opposed to the impressed pressure, only part of the latter is effective in producing current, and this part, which we may call the active pressure, is seen to be—Ea (figure 3)—the resultant of E, the impressed pressure, and Er, the counter pressure. In phase, Er is always 90 degrees behind Ea, while Ea lags somewhat behind E. The current, represented by the heavy line O C, in the diagram, and the dotted curve, is proportional to Ea, and is in phase with it, and so also lags behind E by the same angle ϕ, which is termed the angle of lag.

The angle of lag varies greatly in degree:—from 0, as is the case where there is no induction and C is in phase with E, to almost 90 degrees, when iron is so introduced into the circuit as to strengthen the opposing field, thereby causing the counter pressure to be greatly increased. That C should lag behind E, so modifying the law of Ohm $C = \frac{E}{R}$ and causing the current to be reduced in value, is by no means the disadvantage that it might at first seem, but on the other hand it has distinct

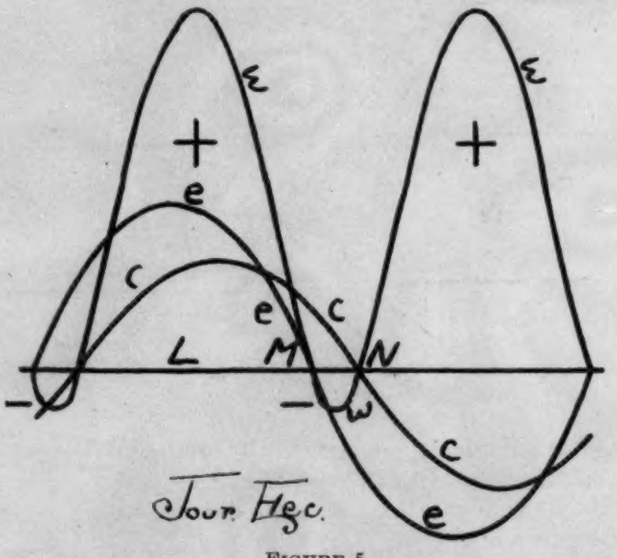
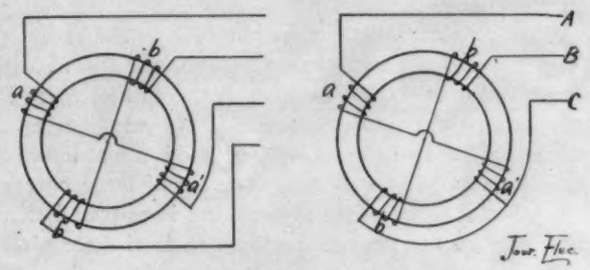


FIGURE 5

advantages. For instance, a machine of moderately high self-inductance can not be burnt out on a short circuit, for the current chokes itself, as it were, and the apparent resistance, called impedance, prevents the current from attaining dangerous proportions by throwing it out of phase with the electro-motive force. It is due to this difference of phase—this variable lagging of the current, that synchronous motors will not fall out of step with their generator, even under great and sudden changes of load; to this also is due the fact that transformers and induction motors may be run efficiently on light load.

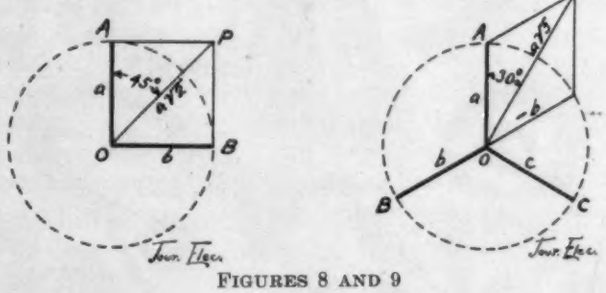
Unlike direct current, the energy of an alternating current circuit is not the product of the amperes by the volts, except in the case where there is no inductance, or where the circuit has slight inductance that is so counteracted by the capacity of the circuit that the current is



FIGURES 6 AND 7

in phase with its electro-motive force, in which event the energy of the alternating current circuit is found in the product of the instantaneous values of e and c.

In figure 4, e represents the electro-motive force, and c the lagging current, while the third curve w is the watts curve which is derived by multiplying the ordinates of e and c and plotting the product to some convenient scale. At the point L, both e and c have positive values and therefore their product is positive; at M, e passes through o and therefore w also passes through o. Between M and N, e is negative and c positive, so their product is negative, and w falls below the zero line, but at N the current is o and w again crosses the line, while beyond N both e and c are negative and their product therefore positive. The effective watts is represented by the difference between the positive + loop and the small negative (—) loop of the curve w. If the current were in phase with the electro-motive force there would be no negative loop, but if it should lag a full 90 degrees or quarter period the negative and positive loops would be



FIGURES 8 AND 9

equal—figure 5—and the current would be wattless:—that is, it would possess no energy whatever. This extreme case is never reached, however, though it is closely approximated in the case of the primary current in a transformer when the secondary circuit is open, for here the circuit contains very high inductance, due to the presence of the iron and comparatively low resistance. The ratio of the true energy consumed to the apparent energy of a circuit, or the ratio of the true watts to the volt-amperes—C E—is called the power factor. The true watts obtained from any reliable watt-meter are equal to C E times the cosine of the angle of lag. The power-factor is therefore equal to the cos. of the angle of lag and when the current and the electro-motive force are in phase the angle of lag is 0, while its cosine is a maximum and equal to 1 and consequently the power factor is a maximum or 100 per cent. The term apparent efficiency is sometimes used in conection with alternating current motors and is applied to the ratio of the total output in watts to the volt-ampere in-put, and so is really the product of the true efficiency and the power factor.

The number of complete cycles that an alternating current passes through in one second is called its frequency; the curve in figure 2 represents one complete cycle. Alternations is a term frequently used to express

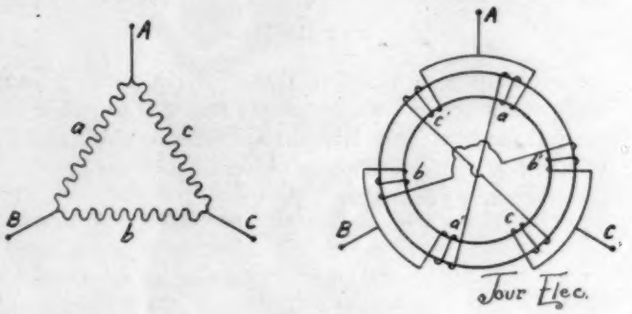


FIGURE 10

the number of reversals of half cycles, but as this is usually given per minute, it is necessary to divide it by 2×60 or 120 to derive the frequency. For example, a current of 7200 alternations has a frenquency of $\frac{7200}{120} = 60$ It would be well if this term alternations were entirely abolished. It only lends confusion, for in all alternating current calculations the number of complete cycles per second is used, not the number of half cycles; also in electro-magnetic work the second is the unit of time and not the minute.

When alternating current machinery first came into use all sorts of frequencies were tried ranging from 25 to 160, but this state of affairs was unsatisfactory and the apparent need of a standard manifested itself. At low frequencies—anywhere below 40—the blinking of the lights is quite perceptible, while the transformer losses are greater at low frequency than at high. This led to the larger electrical companies each adopting a standard of its own, but generally ranging from 100 to 133, as that was most satisfactory for lighting purposes. Later, as induction motors were introduced, other factors entered into the problem; the speed of the motor varies directly with the frequency and inversely as the number of poles, so to reduce the speed of small units to reasonable limits, either the frequency had to be reduced or the number of poles increased, and as it is impractical to build small motors with a large number of poles, the former method had to be resorted to, with the result that a frequency of 60 has been almost universally adopted where power and lights are furnished from the same machine—this compromise being very satisfactory for

both. There were two other reasons for adopting the lower standard. The line reactance varies directly with the frequency, and therefore with a higher frequency the induction of the line is increased with a consequent greater line drop—quite an important item in long distance transmissions. Also with the growth of stations came

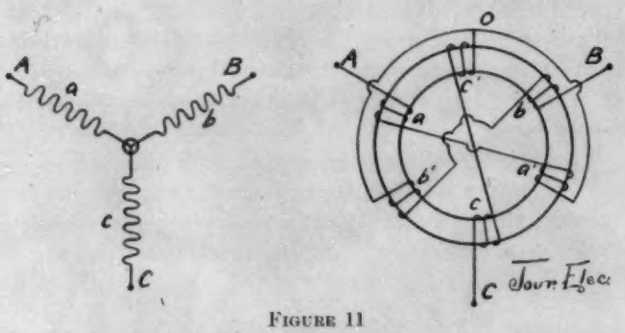


FIGURE 11

the advisability of coupling dynamos in parallel, and while machines of high frequency run well together under full load, at light load they are apt to shirk and divide the load unevenly—an objection not applicable to low frequency generators.

Part II

POLYPHASE CURRENTS.

A SINGE-PHASE alternating current is not practical for large power transmissions because single-phase motors are comparatively inefficient and costly; added to which they are not self-starting unless some special starting device is resorted to, which practically prohibits the use of units much over 10 horse-power. Of course this does not apply to large synchronous motors running continuously, for here the difficulty of a small starting motor is of min-

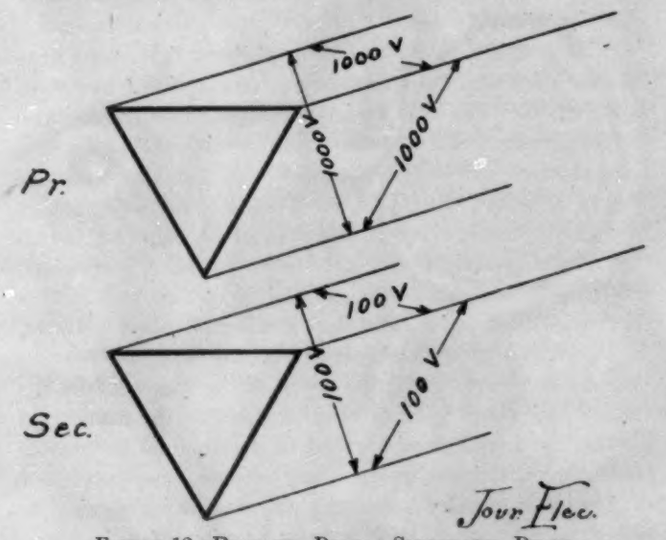


FIGURE 12—PRIMARY, DELTA; SECONDARY, DELTA.

or importance, but it is a rare case where a system consists of large synchronous motors only, and for this reason polyphase systems are used. They are essentially two or three, or in very rare cases, more than three separate and distinct alternating currents of the same frequency but of different phase, and while they embody all the advantages of the single phase system, they in addition overcome many of the most serious disadvantages attending single phase work.

When two currents are produced by the same machine it is called a two phase dynamo, and the windings are spaced 90 electrical degrees apart, so that there is a difference of one-quarter of a period or cycle between the currents in the two phases,—when one is a maximum the other is zero. If the system consists of three currents, it is called a three phase system and is operated with a difference of 120 degrees between each of three phases.

There are two ways of transmitting two phase currents: First, with the circuits entirely independent of one another, in which case four main wires are required as in figure 6, or second, when the two circuits have a com-

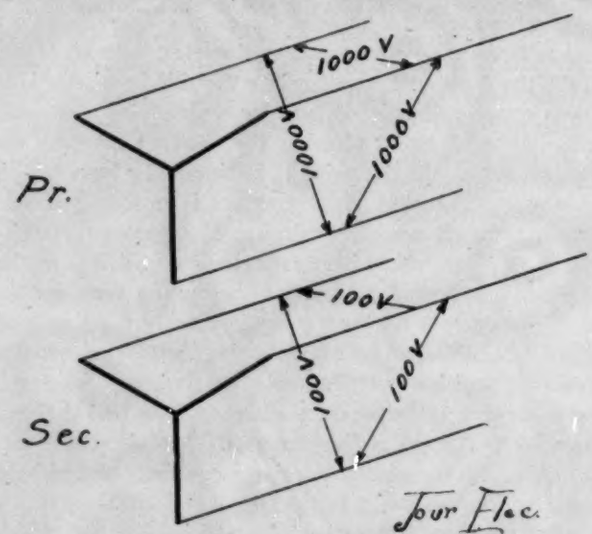


FIGURE 13—PRIMARY "Y," SECONDARY "Y."

mon return wire and three wires only are used as in figure 7. The value or amount of current in the third or common return wire C is at any instant equal to the algebraic sum of the currents in the other two wires, and its effective value is equal to the resultant of the separate currents or to their vector sum. Provided the system is balanced by a load evenly divided between the two phases, this value is equal to $\sqrt{2}$ C, where C is the current in one circuit.

This can best be illustrated by the parallelogram of forces as shown in figure 8 where a and b represent the current in the wires A and B, and are equal in value, though a is 90 degrees ahead of b in phase. The current in the common return wire C is equal to O P or a $\sqrt{2}$ and in phase it is half-way between a and b, or lags behind a by 45 degrees.

In a three phase system, instead of using six wires to form three separate circuits, it is customary in practice to save copper by transmitting on a circuit consisting of three wires. This is done in several ways, but all depending on the manner in which the coils of the machine are connected up.

When the coils of a three phase machine are so connected as to form the three sides of an equilateral triangle, the leads being connected to the three corners of the winding, it is termed a delta connection from the Greek symbol △, which it resembles. The pressure between any two line wires is that generated by one coil, that is, the coils of one phase, while the current in each wire is equal to the vector sum of the currents in the two adjacent coils to which it is attached, and in a balanced system this is equal to 2 C cos. 30 degrees, or $\sqrt{3}$ C, –C being the current in one coil. In figure 9, a, b and c are the three currents in the coils; the current carried by each of the line wires is O P, or a $\sqrt{3}$

Another way of connecting a three phase system is

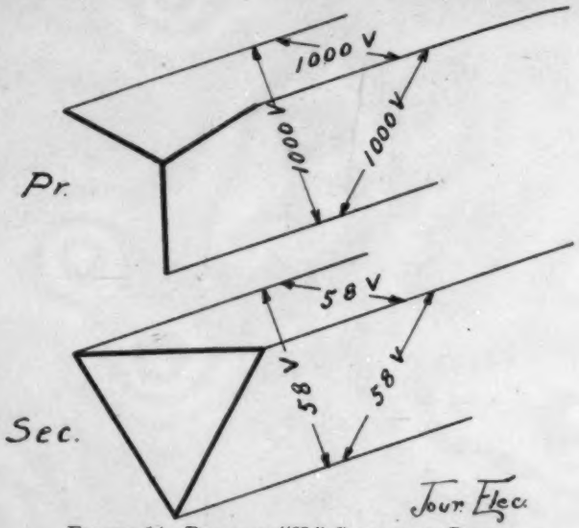


FIGURE 14—PRIMARY "Y," SECONDARY DELTA.

shown in figure 11 in which one end of each coil is connected to the three transmission leads, the other three ends being connected together at a common or neutral point, for the algebraic sum of these currents must at all times be zero. This is called a "star" or "Y" winding. The pressure between any two line wires is $\sqrt{3}$ E, where E is the pressure generated by one set of coils, as can be shown by taking a, b and c in figure 9 as voltages instead of currents, but in this case it is evident that the current in each line wire is the same as that generated in the coil to which it is connected.

Various other ways of connecting up the coils of a three phaser have been devised by Dobrowolsky and others, but they are all combinations of the delta and Y and the special advantages claimed for them are, like the particular beauty of each individual infant, more or less in the fond imagination of the authors of their being.

When stepping down from the mains of a three phase system for lighting purposes, if the number of lights be small, as in a private house or small store or office, it is usual to place a single transformer across one leg, but where the number of lights is large, transformers are connected across all three legs and the secondaries are also run on three wires. When either the primary or the secondary leads are connected two and two so that they form a triangle, they are connected delta, but when one terminal from each is joined in a common center and the three free ends are connected to the three mains,

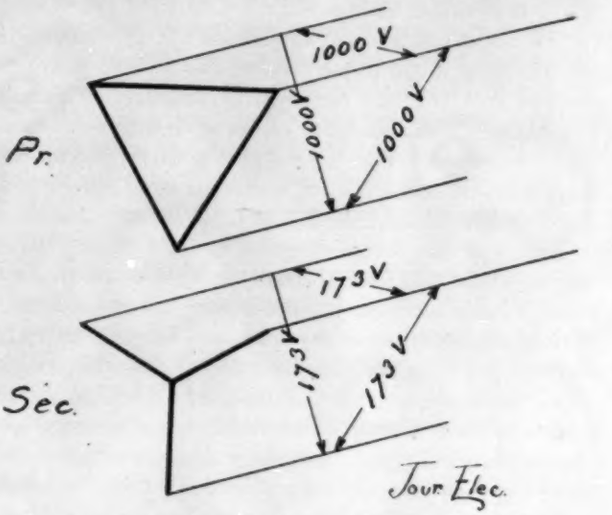


FIGURE 15—PRIMARY, DELTA; SECONDARY, "Y."

they are said to be Y. By making different combinations of the primary and secondary connections three different voltages can be obtained off the secondary. For example, let us assume the ratio of the primary to the secondary of our transformers to be 10 to 1, and the pressure between our primary mains 1000 volts.

(1) If both the primary and secondary are delta connected as shown in figure 12, it is clear that the pressure on the primary turns is the full 1000 volts and that the pressures across the secondary mains is the same as in secondary windings of the transformers—100 volts.

(2) Connecting both primary and secondary Y (figure 13) we gain the same result but in a different way, for the pressure across the primary coils is not 1000 volts, but $\frac{1000}{\sqrt{3}}$ or 578. The pressure the secondaries are subjected to is 58, but yet the secondaries are 100 volts, for again turning to figure 9, let the points A B and C represent the three secondary leads. The pressure in the coil A O is a=58 volts, but between A and B it is O P $=\sqrt{3}$ a=100 volts.

(3) If the primaries are connected Y and the secondaries △ the pressure across the primary coils is as in (2) and stepping down 10 to 1 show the secondaries 58, but in this case the secondary mains are the same as the coils—only 58 volts. This is shown in Figure 14.

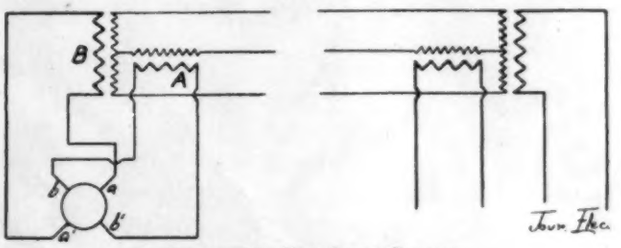


FIGURE 16—THE SCOTT SYSTEM.

(4) With the primaries connected in △ and the secondaries Y, the pressure in the primaries is as in (1)—1000 volts. That in the secondaries 100 volts, which gives

$100\sqrt{3}=173$ as the voltage in the mains. This last is the most common connection, because it is the most economical. It is shown in Figure 15.

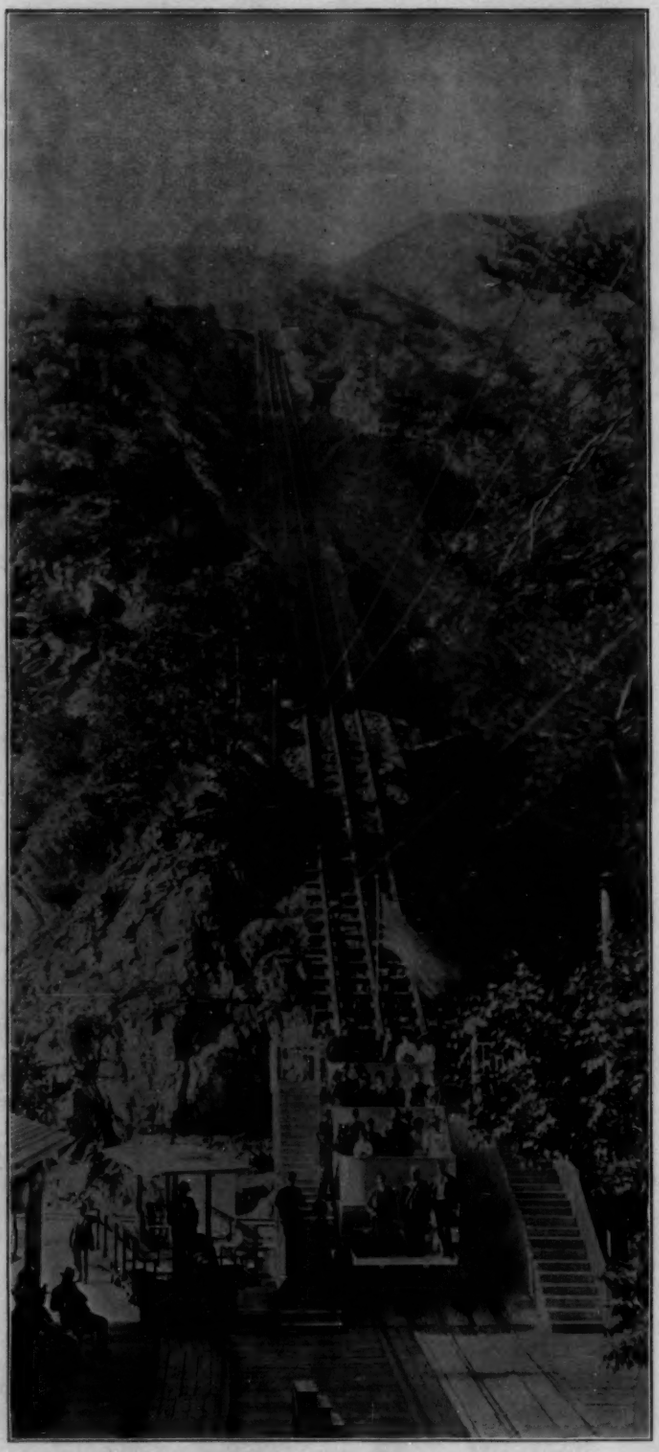
The Scott system of transmission is a method for transforming a two phase current into a three phase current in the stationary step up transformers; of transmitting three phase and again stepping down to two phase for distribution. Thus to the saving of copper by three wire transmission is added the advantage of two phase distribution. To accomplish this, Mr. Scott connects the primaries of two transformers A and B—figure 16—to the leads of a two phase dynamo. The secondaries of these transformers have a different number of turns, A having 0.87 times as many as B. Of the secondary leads of A one is connected to one of the transmission wires, while the other is cut into the middle of the secondary of B as shown. The two B leads are connected to the remaining two wires, and thus three equal pressures 120 degrees apart are obtained. At the further end of the line this process is reversed, and by two similar transformers the three phase current is changed to two phase.

Transportation

DETAILS OF THE MOUNT LOWE RAILWAY.

A correspondent, in discussing the recent reference in these columns to the Mount Lowe Railway, points out an interesting feature of electrical installation that has hitherto been overlooked and which, though hardly worthy of emulation, illustrates the extremities to which the electrical engineer is sometimes driven by the iron clad exaction that come what may, a certain result must be accomplished with an expenditure that may not exceed a given amount. This interesting feature is nothing less than the fact that the 500-volt railway and power circuit, the 1100-volt primary circuit of the alternating incandescent system and the arc lighting system each and all use the rails of the railway system as a common return to the power house. It is understood that this arrangement, which has been operating succesfully for three years or more, is to be displaced by properly constructed independent circuits during the coming summer.

The correspondent also sends the accompanying illustrated of the incline of the Mount Lowe Railway. together with the information that two sources of water supply were available under widely different conditions as to head and quantity, both of which it was desired to utilize. One of the streams comes from the summit of Echo Mountain with a fall of 1,250 feet and the other from Rubio Canyon with a fall of 287 feet, the water from each being brought down to the station in separate lines of pipe and applied to the wheels separately. The power station consists of two Pelton wheels of the steel disc type, mounted on the same shaft with iron housing and bed plate.



INCLINE OF THE MT. LOWE RAILWAY.

The high-head wheel is 40 inches in diameter and develops 100 horse power with a 1-inch nozzle, while the wheel for the lower head is 19 inches in diameter, to which are applied two streams developing 50 horsepower, both wheels running at 800 revolutions, the vary-

ing diameters being necessary to give the same speed and still conform to the velocity due to their respective heads. The power developed is transmitted to the top of Echo Mountain, where it drives the hoisting machinery of the cable incline here shown, which is 3,000 feet in length and laid on a grade of 48 per cent.

Mining

ELECTRICITY IN MINING.

IT is not a difficult matter to convey to managers of mining properties an understanding of the chief terms of electrical parlance, by comparing these terms with the various conditions of water—that agency with the action of which none are more familiar than miners themselves. As one miners inch, the unit of volume of water, delivered under a pressure of 480 feet head, will produce one mechanical horse power, so will one ampere, the unit of volume of electricity, if delivered under a pressure of 746 volts, produce one mechanical horse power. The analogy is practically perfect and the busy man of mining affairs who has to do somewhat with electricity need not necessarily delve into electro-techniques beyond that depth which returns the understanding that almost every electrical term in every day use finds an analogue in a familiar utilization of water.

It has been shown that the ampere is comparable to the miners inch, and that the volt is comparable to the head-in-feet, or the pressure of a stream of water. The power obtainable from a stream of water may be found in the product of its weight and velocity—this product being expressed in "foot-pounds"—and there are 33,000 foot pounds to a horse power. Similarly the power obtained from a current of electricity is found in the product of its amperes (weight or volume) and its volts (pressure or velocity)—this product being expressed in "watts"—and there are 746 watts to a horse power. Where any power of considerable magnitude is under consideration, its equivalent in watts would be so great numerically as to be inconvenient of expression, hence the Greek prefix "kilo" signifying 1,000 is used exactly as in the metric system, and thus the energy of one hundred and seventy-five thousand watts is expressed as 175 kilowatts. Since in the watt is represented the product of volts and amperes, it is obvious that 175 kilowatts, for instance, may represent an energy of 10,000 volts and 17.5 amperes, or that the two factors may have any value which will give 175,000 as their product. Here the cited analogue still holds, for the same is true of the energy of a stream of water when expressed in foot-pounds.

But water in flowing through a pipe line encounters resistance from friction with the sides of the pipe and from bends or other changes in the direction of flow. Hydraulics characterize this resistance as the "co-efficient of resistance," which is a variable quantity, and which is not expressed in terms of standardized unity. It is practically in the same manner that a current of electricity, in traversing a wire, encounters resistance, the amount of which varies greatly with the metal of which the wire is made. Silver offers the least resistance of any metal to the flow of electricity; copper has about 98 per cent of the conductivity of silver, while iron has less than one-sixth of the conductivity of copper. In electricity the unit of resistance is the "ohm" and its value is such that when a pressure of one volt is applied to such a length or cross section of wire that the current which flows through the wire will be one ampere, then the resistance of the wire will be one ohm. A parallel to this would be found in hydraulics where the length and diameter of a pipe is such that under a head of one foot, exactly one miners inch of water would flow through the pipe. The co-efficient of resistance of this pipe is analgous to the term of "ohm"—the unit of electrical resistance.

Electricity, if of the direct current form, traverses the conducting wire in one direction, as does water in a pipe line. Sometimes pulsating currents are used and these, like water in the supply pipe of a hydraulic ram, flow in a single direction, but are interrupted periodically. Then there are alternating currents of electricity which are of a vibrating character and oscillate in one diection and then in the other, alternately, as water would do in a pipe, each end of which is connected to a respective side of a piston chamber having no valves, in which event the direction of flow of water through the pipe would alternate with the direction of the piston stroke.

It is unfortunate for lucid analogy that there is no practical, familiar parallel in hydraulic practices by which the nature of the varieties of alternating currents may be illustrated, and this misfortune is the greater because of the knowledge that alternating currents are destined to take a far more important part in all mining applications of electricity, except in electro-metallurgy, than any other form of the ubiquitous agency called electricity. Hydraulic conditions of suppositional forms must therefore be improvised to complete the analogue.

An oscillating current of the form described, in which electricity flows back and forth as water in a pipe connected to a piston chamber without valves, forms the simplest type of alternating currents, and such a current is termed a "single phase" current. This may be fixed in mind by conceiving the water device to be driven by a single piston, actuated from a single crank disc, throwing the water in the pipe into a state of single oscillation or single alternation—technically "single phase." The rate of this oscillation, when applied electrically, is termed the "periodicity," or the "rate of alternation" of the circuit.

Suppose however, that there are two such single pipes, entirely independent from but paralleling each

other, and containing water alternated in flow as in the previous instance, by valveless piston chambers. If the pistons of the respective chambers are always in unison as to speed and position as they would be were they driven from the same crank pin of a shaft, then the volumes of water in the two pipes would pulsate in perfect harmony as to rate, speed and direction, or to use an electrical term, the currents would be in "synchronism." But should the two pistons be actuated from independent crank pins placed diametrically opposite on the driving shaft, then the flow of water in one pipe would be exactly opposite to that of the water in the second pipe, which may be described as a "two current" or "two flow" system. It is precisely such a condition as this which exists in the two electrical circuits of the "two phase" alternating current electric transmission system.

Again, instead of the two valveless chambers and pipe system just described, assume that there are three such systems, each identical in construction to the others, with the solitary exception that the pump pistons are respectively driven from crank pins placed 120 degrees apart on a shaft, in which event the direction of flow in pipe No. 2 will be one-third of a stroke or revolution behind that in pipe No. 1. Similarly, system No. 3 will "lag" one-third of a stroke behind No. 2; system No. 1 will lag one-third of a stroke behind No. 3, and so on, all this being analgous to a "three-phase" alternating current system. Thus are illustrated the different types of polyphase systems,—as all varieties of alternating currents in excess of the single phase system are termed.

But what is the advantage of different phases? Simply this: As hot water in flowing through a pipe influences the temperature of the air surrounding it, so does electricity in flowing through a wire influence the ether surrounding the wire,—in fact, magnetizes it, the direction of magnetic pull (so to speak) varying with the direction of electric current flow. A north magnetic polarity and a south magnetic polarity will attract each other as all know, and owing to the fact that in two-phase systems the direction of electric current flow in the two circuits is always exactly opposite, the ether surrounding one wire is always of exactly opposite magnetic polarity to the ether surrounding the other wire, hence in two-phase electric motors there is always a state of mutual magnetic attraction between that part o the motor conaining the "leading" phase and that part of the motor containing the "lagging" phase.

Single phase circuits are by nature restricted to but a single magnetic polarity of the surrounding ether at a given interval, and as it takes opposite magnetic polarities to exert attraction toward each other, it is evident that the production of power from single phase current is seriously handicapped by its own inherent characteristic. This idea roughly explains why the development of single phase motors is so tardy.

In three phase systems, the phase impulses follow each other consecutively with absolute regularity, and inasmuch as "fields" or atmospheres of magnetism attend the appearance or disappearance of each impulse, it is evident that the revolving motion of these consecutive impulses impart a similar rotation to the attending magnetic field, which explains the term "rotating field." If a strong magnetic field revolves, obviously any magnetic body placed within that field will tend to revolve with it and to this principle is due the three phase motor.

Finally, the transformer or converter is just what its name indicates, or rather, what its name would indicate were the word electricity prefixed. It is merely a device for automatically transforming electrical energy or "wattage" from one value to another. The transformer is to electricity what an appliance would be to hydraulics that would take the energy of a small stream of water at high head and transform it with but small loss to the energy of a large stream of water at low head, or vice versa. Were there an equivalent appliance in hydraulics, this "hydraulic transformer" could automatically convert the irrisistable tidal flow, or any portion of it, to a much smaller volume of water at a tremendously high head, thereby enabling an easy solution of the long hoped for utilization of the tides for power purposes.

It must be borne in mind that the foregoing has been written with the idea of imparting most elementary ideas to those who have neither time nor inclination to become possessed of any but a superficial knowledge of the chief terms and principles which are fundamental in electrical practices. The wisdom of experience has well taught that "a little knowledge is a dangerous thing," and the above is a little, indeed a very, very little, of the knowledge of which science is possessed concerning electricity, and to accept every statement given as an indisputable exposition of most recent practices would be an error, for, as intimated, an elementary and brief explanation of a profound subject can not be swerved from its purpose by considerations other than those of the barest generalities.

Electro-Therapeuty

RECENT USES OF ELECTRICITY IN MEDICINE.

By Philip Mills Jones, M. D.

THE very general interest in the work and value of the X-rays, seems to have aroused a new interest in electro-therapeutics generally, for certainly there are more items in the medical press on things electrical than was the case two or three years ago. I note several "new treatments" that

are old, almost as old as electric-therapeutics itself. There are also some things noted that are new and that seem to be really valuable; certainly the signs of renewed interest in electricity is promising if nothing more.

Dr. John Winslow, in the "Medical Record" for February 26th, reports a case of hysterical aphonia treated by the induced currents and cured. He found that if the apparatus was so arranged that the induction coil would be heard to operate by the patient and the circuit from the secondary to the patient left open, the relief would be just as certain, thus demonstrating that the action of the currents, per se, had nothing to do with the actual cure of the patient. The experiment was cleverly planned, but why a switch should be called a "rheotome", is something quite beyond the comprehension of the writer.

Dr. Alex. J. C. Skeen, in an article in the "American Medico-Surgical Bulletin", has discovered that the electro-cautery (why "galvano-cautery"?) and the use of the constant direct current in sufficient current strengths to produce electrolysis, are excellent in the treatment of certain forms of neoplasm of the skin and mucous membrane. He reports the result of his use of these methods of treatment in a number of cases, principally of naevus and epithelioma, in which a perfectly satisfactory result was obtained. There seems to be nothing new in the article, except the addition to the list of cures of three more cases.

The "Philadelphia Medical News," the new medical journal of Philadelphia of which Dr. Geo. M. Gould is editor, states in its issue for March 12th, that during 1897 there were 416 cases examined by the X-rays at the St. Thomas' Hospital, London, England. This number may seem large considering the short time that the rays have been in use, but the writer examined during the same time, a few over three hundred cases, and but a small number of these were hospital cases. The same journal is responsible for the statement that there is a proposition, in Paris, France, to establish a radiographic service in each of the hospitals under the control of the Assistance Publique. The service is to be under the direction of the medical staff of the hospitals. Evidently Paris prefers to be in the front rather than in the rear of the procession, to lead rather than to be led. The day will come when it will be almost a good ground for a malpractice suit, if a case of fracture or dislocation has been treated without an examination by the X-rays. In connection with the above remarks, I remember an article in the "Wiener Klinische Wochenschrift", of February 17th, describing a method of locating foreign bodies in the eye, by means of the X-rays. The method described differs but slightly from the method that has been used in this country for the same purpose for some time.

An improvement on the method of Newman for the treatment of urethral stricture by electrolysis, is mentioned by the "Arch d'Elect. Med." for November, 1897. The improvement is devised by Debedat, and the article in question is written by him. He suggests the use of an electrode slightly different from that commonly used in that it is insulated from the urethra entirely, with the exception of a small portion at the olivery extremity; the method of application is also somewhat different, for he passes the electrode through the stricture before closing the electrical circuit; the electrode is then connected to the source of e. m. f., and upon withdrawal the electrolytic action is secured directly upon the stricture and nowhere else. He reports the successful use of his method in a number of cases and gives careful data of two of them; he finds that no case so treated had to suffer any further surgical interference and thinks that in a large number of cases this may be the method of election.

The meeting of the Chicago Medical Society for March was devoted to the discussion of cholelithiasis, several gentlemen giving their results of attempts to skiagraph gall stones; Drs. Bevan, Schmidt, and McArthur had tried, with the following results:

Dr. Schmidt's experiment was made with the gall stones in a normal salt solution so arranged that the rays would pass through about three inches of the solution; the shadows of the gall stones were but little darker than the solution. Dr. McArthur tried comparative exposures of gall stones and other concretions, and found that the gall stones cast very faint shadows as compared with other stones: Dr. Bevan embedded the gall stones together with lead, renal, and vessicle calculi in liver so arranged that the rays would penetrate from two to eight inches of tissue before striking the plate; he found that while the lead cast a very clear shadow and the other concretions cast quite distinct shadows, the gall stones, even those of good size and high specific gravity, cast shadows that were almost imperceptible; he concluded that the same stones in the living body would not have cast any shadow that could have been identified, owing to the movements of the body during respiration. The proceedings are reported at some length in the "Philadelphia Medical Journel" for March 19th.

The "Deutsche Medicinische Wochenschrift," for February 17th, contains an article by Carl Beck on the "Diagnostic Significance of the Roentgen Rays in cases of Arterio-Sclerosis." Beck presents radiographs of a case showing shadows of the radial and inter-osseal arteries on both sides, while the arteries of the head and neck and the aorta gave no radiographic appearance of thickening, thus confirming the appearances found in the temporal and facial arteries upon operation, and suggesting that this may be a good method of determining the extent of arterio-sclerosis. The above abstract is from the "Philadelphia Medical Journal."

The same journal contains an article by Dr. G. Betton Massey on "The Radical Cure of Malignant Disease by the Cataphoric diffusion of Mercury from Cold Electrodes, with Details of late improvements in the Author's Method". The article reports three cases, making in addition to the eight already reported by the same author, eleven in all. It is hardly fair to consider the method of treatment as a "cure", for the reason that no case has gone more than a year since the treatment; yet the results thus far reported are certainly encouraging and should lead to a more extended trial of the treatment suggested. The special electrodes used and designed by the doctor are illustrated in the journal quoted and the particulars of the method well described. A hollow gold electrode is the one now used, and the mercury is allowed to fill the tube, after it has been thrust into the tissue to be operated upon; a current of from 800 to 1500 milliamperes is recommended, the operation being done, of course, under a general anesthetic. There is considerable reaction to the treatment, which increases as the amount of cancerous tissue is lessened, but the pain is never intense. A selective action of the mercury is noted by the doctor, who states that the healthy tissue is not affected by the treatment.

The cases reported are certainly very remarkable in that they were all inoperable cancer.

The "Journal of Electro-Therapeutics" for March contains several articles of some interest. The question as to the nature of the causes of the increase in the effect of certain drugs, as for instance mercury, potassium iodide, etc., produced by the passage of a current, is discussed by Dr. F. M. Frazer at some length and with a good deal more clearness than is usually the case when physical problems are treated by the medical practitioner. The conclusion seems to be that the increased effect is due to the fact that the drug is acting in a nascent condition, owing to the splitting up of the molecules by the current, and as is well known, the action of a drug in its nascent state is greater than the action in the ordinary state. Dr. Clara E. Gary reported three cases of general pelvic disturbances which she had treated and cured by electricity, in one or more of its various forms; the results were good and they were average cases that may be met with and treated almost any day by the general practitioner. One had suffered three operations and the others had been advised to seek surgical interferance. The same journal contains a translation of the article from the "Rev. Internat. d'Elect." by M. Giles, on the application of the methods used in the treatment of urethral strictures, to the strictures of the esaphagus. There seems to be nothing new in the method of treatment suggested other than the common sense changes that would occur in the modification of the one treatment to the esophagus. A number of very excellent cures are reported.

Some radiagraphs have been made in Paris, France, of a cadaver; the subject was first injected with a mixture of shellac dissolved in alcohol, carrying in suspension metallic powder,—the ordinary "bronze" powder answers very well. The resulting skiagraphs showed the arterial distribution remarkably well and are said to have cleared up some disputed points, though the points in dispute are not mentioned in the article.

Transmission

AN 110-MILE CALIFORNIA TRANSMISSION.

The most interesting development of the month has been the somewhat premature announcement in San Francisco papers, of the organization of a strong company for the purpose of effecting the electrical transmission of not less than 10,000 horse power from Blue Lakes City to San Francisco, a distance of 110 miles by the pole line surveys.This new company, which is destined to be the cynosure of the attention of the electrical engineering world in the very near future, is composed of the principal members of the California Exploration Company, under the presidency of Prince Poniatowski, and of the Blue Lakes Water Company, under the presidency of Mr. W. Frank Pierce. Prince Poniatowski is president of the new corporation and the company has been so fortunate as to secure the services of Dr. F. A. C. Perrine as its consulting electrical engineer. The money for the building of this noteworthy transmission has been secured and the active prosecution of its installation now only awaits the conclusion of a few final investigations into the commercial feasibility of the project.

Readers of the Journal of Electricity are familiar with the Blue Lakes and California Exploration Companies through the descriptions of their properties appearing in the Blue Lakes Edition" of the Journal in October last. Aside from the natural flow of the Mokelumne river, the Blue Lakes Water Company possesses a water system having a storage capacity of twenty-one thousand billion gallons which, considering the high head at which the water may be used (about 1040 feet), constitutes the most abundant water power to be found in the State of Caifornia. The amount of this power is in the neighborhood of 50,000 horse power and the cost of its develpment is estimated to be about $100.00 per horse power delivered in the pipe line. Its distance is 49 miles to Stockton, 51 miles to Sacramento, 97 miles to Oakland and, as stated, 110 miles to San Francisco, possessing in all a population of nearly 600,000.

The proposed transmission will possess features that, being without precident, will be both interesting and tartling. Hitherto the Bay of San Francisco has presented a barrier that has been believed to be impossible to any electric transmission into San Francisco, but acting under a suggestion of the engineering department of San Francisco office of the General Electric Company, the circiuits will in all probability be brought across the bay by pole line rather than through submarine cable, as the pole line will permit the carrying of very high potentials at but a tithe of the cost of cables for carrying an equal amount of power.

ELECTRICITY IN THE SHOW BUSINESS.

There is hardly an exhibition now presented to the amusement loving public that does not possess some electrical feature of more or less importance and in some of them electricians are affordeded opportunities for bringing out exceedingly clever effects that are possible by no other agency. Of such a nature is the interesting exhibition now open on Market street, near Larkin street, San Francisco and known as "Around the World," the mechanical and electrical engineering features of which were all planned and executed by the students of the van der Naillen School of Engineering. The electrical portion of the exhibition was placed under the direction og Mr. A. R. Talamentas, one of the students of the electrical engineering course, to whom great credit is due for the exceptional genius and good workmanship displayed.

A PERMANENT POSITION WANTED.

A married man of exemplary habits and wide experience in the operation of steam and water power electric stations, desires a situation. He is fully competent to erect, and operate electric plants for every description of light and power service and desires a permanent location rather than high wages. He has had ten years' experience on the Pacific Coast, three of which were spent in high potential transmission service. Best of references.

Address: "C. H. R.," Care of F. G. Cartwright, 18 Second St., San Francisco.

THE JOURNAL OF ELECTRICITY.

An Illustrated Review of the Industrial Applications of Electricity, Gas and Power.

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EDITORIAL.

THE LINING OF THE RAINLESS CLOUDS.

The general complaint which is going up from all sections of California fornia over the scarcity of rain during the winter just ended finds official confirmation in the Bulletin of the United States Department of Agriculture, which reports that the drouth in California continues and that "the deficiency in rainfall is nearly one inch in the northern coast section; half an inch in the great coast valleys, decreasing southward, and about a quarter of an inch south of the Tehachapi * * * The continued absence of the late spring rains gives little hope of relief."

Continuing, the "Crop Bulletin" states that "Grain and hay have suffered severely and the outlook is discouraging. Stock is starving and horses can be bought in some localitites for $1.50. Sheep are perishing. Fruit is doing well, but as orchardists have not faced such a dry season before, the future is uncertain."

With such an extraordinary condition of climatic affairs confronting a state whose plenty is proverbial, it is a natural consequence that other interests should be threatened along with these which "have not faced such a dry season before." Among these will probably be the electric transmission interests, as present conditions indicate that the coming summer will be an unprecedentedly trying season to some of them in the matter of water supply, to overcome which heroic measures may have to be adopted. However unfortunate it may be that such exigencies are possible, it is well that the issues they present should be fairly met and squarely overcome, for they are factors in the result that must ultimately receive the judgment of the cold business precepts that hold absolute sway in the counting house of commercial feasibility. The impartialty of this court of nnal resort is conceded and while it will take cognizance of the difficulty that will probably beset some electric transmission plants from the drouth, it will also recognize that the production of steam power will be attended with probably equal difficulties through the impending Hispano-American war, one of the results of which will be the cessation of the importation of coal.

Though the rain clouds have been conspicuous in California during the past winter by their absence, it is safe to say that, where ever they may be, their linings are silvery for transmission interests through a new line of business that the propective dry season is forcing upon the electrical fraternity. High load factors develop economy in operation whatever be the prime mover, and while the great orchard and vineyard districts of the State are threatened with a water famine through the scant supply for the irrigation systems, the lower strata of the vast valleys of California always contain unlimited supplies of water which is most economically brought to the surface by electric pumping stations operated from electric transmission lines. Hundreds of horse power in electric motors have already been sold this spring for this most desirable class of work—and the market has but just opened with the fixing of the belief in many localities that underground sources rather than the irrigation ditches, furnish the most trustworthy souce of the water supply upon which hangs the life thread of the limitless horticultural, viticultural an agricultural resources of the great Golden State.

HE WINS THE SECOND PPIZE TOO.

It is now several months since the awarding of a leathern medal of great rarity to Mr. Charles R. Lloyd for the sublimity of his mental acuteness in permitting evidence to be introduced under which a court of justice at San Bernardino was compelled to instruct the jury to the effect that the measurement of water power was a matter of individual opinion, rather than a definitely ascertainable fact. As a consequence the jury returned judgment against Mr. Lloyd for about $14,000.

As the time for the awarding of the second trophy approached, there appeared many aspirants for the distinguished honor of bearing it off, but it has transpired that the dark horse in the race was none other than Mr. Lloyd himself, and so valiantly did he execute his inborn part that now with the utmost graciousness does the "Journal" confer upon him the proud privilege of wearing the second trophy of the series. Like the first medal, the second prize too is a finished product of the tanner's art, but the workmanship upon it has given it a value involving some $20,000.

How Mr. Lloyd has come to be possessed of this new honor is being told and oft repeated at every rondavous of electrical and corporate nabobs. It seems, so the narative goes, that in anticipation of an adverse decision in the San Bernardino suit, the well known subject of this anecdote put every bit of his property out of his name so effectually that in the undiscerning eyes of the law he was a pauper indeed. Verily, though there were inviting places whereon to lay his physical head, leagally speaking he had no financial head which he might lay. And so it came to pass that the $14,000 judgement remained unsatisfied.

But the day of the annual meeting of the stockholders of the San Francisco Gas and Electric Company came and, as there was to be a gathering of the clans to celebrate the occasion, Mr. Lloyd hied himself to his resources and, after secluded consultation therewith, was duly qualified as the holder of a certificate for 200 shares of Gas and Electric stock, which of course, proved an open sesame to the joyful gathering. With unalloyed pleasure he entered the meeting, with unalloyed displeasure he departed for in truth, the one Lloyd had learned that the attorney of the San Bernardino plaintiffs had attached the 200 shares in satisfaction of the unpaid judgment. Presently a bond for $20,000 was forthcoming to release the stock and now, behold the leather medal, the second of the "Journal's" series of booby prizes, bedecks the veteran breast of Mr. Charles R. Lloyd.

AN INSTANCE OF ELECTRICAL VAGARY.

One further reference to the much-talked-of pair of Fresno eagles that were incinerated on the line of the San Joaquin Electric Company, may be pardoned in connection with a very interesting piece of information that has been received concerning the two owls that were killed on the line of the Power Development Company, of Bakersfield, Cal., in exactly the same manner as were the eagles; namely, by alighting on a 10,000-volt transmission line.

It will be remembered that the Fresno eagles were burned all but completely out of existence, there remaining only one skull and four claws with parts of legs from which the character of the birds could be identified. With the Bakersfield owls, however, the only evidence of physical injury to be found was the fact that both eyes of each bird had been put out. No other mark of injury of any nature was to be found on either bird. It is no wonder then that in referring to the two incidents, one is impressed with the vagary of high tension electricity which utterly annihilates in one instance and but snips out the spark of life in the next.

Visitors to the coming Electrical Exhibition soon to be held in Madison Square Garden, New York, will have the opportunity of seeing the interesting and gruesome relics of both the eagles and owls, as they will form conspicuous features in the "chamber of horrors" to be then shown.

Passing Comment

An Editorial Review of Current Events and Comtemporary Publications.

STEAM IN FUTURE CENTRAL STATIONS.

It has long been realized that the bringing of the steam engine to its present state of efficiency in operation and regulation was due to the introduction of the dynamo and the condition imposed by it necessitating a well regulated steam power of high and constant speed. The history of this development is admirably brought out in the current number of "The Engineering Magazine" in an article by Mr. Charles T. Child on "The Steam Engine and the Dynamo," and the one idea that stands out above the others there given is found in the observation that the steam turbine promises to drive dynamo designers to the consideration of the very highest speeds for their machines. Slow speed motors will probably ever embody advantages that will make them always the most desirable means for the conversion of electrical into mechanical power, and at the present time the almost universally accepted belief is that in slow speed generators are to be found the best practice attainable for direct connection to steam engine units, but the steam turbine bids fair to demand a return to the earlier days when, as the output of a dynamo is directly proportional to its speed, considerations as to first cost demanded that the dynamo be driven to its utmost speed capacity.

Well does the writer referred to observe that the remarkable efficiency of the steam impulse wheel, its extraordinary simplicity, and the high output of power per unit of weight secured by its use, make it the ideal machine for the conversion of thermal into mechanical energy and for dynamo driving, save for the one apparently insurmountable difficulty of its enormous speed of rotation, which is often as high as 30,000 revolutions per minute. Thus far, the unmanageable velocities encountered have forbidden the commercial extension of the method, though some combinations of steam turbine and dynamo are successfully working under commercial conditions. Hitherto no attempt has been made to design a dynamo for direct operation at the speed of the turbine, but the effort has been to reduce the speed, either by gearing or directly to that of the present type of dynamos. The analogy of the case of the dynamo and reciprocating engine twenty years ago seems to point to some compromise method. Certainly gearing will never be tolerated so long as there is the least hope of directly reducing the speed of the steam turbine. There appears to be good reason for thinking that compounding offers a solution of the difficulty and that speeds as low as 2,500 revolutions per minute may be had directly from a multiple wheel, multiple expansion turbine.

There appears then, two difficulties to be overcome before the operation of steam tubines and dynamos in direct connected units can become an accomplished fact, namely; the speed of the turbine must be reduced or, assuming that it is impracticable to build such high speed generators in alternating current types as will give sufficiently low periodicities to be available for use under present conditions, electrical advancement must be very great along the line of high frequency application to enable the utilization of the alternating currents that would be most readily adapted as the output of the new types of generators. The solution of one difficulty as presented would furnish that for the other, and the belief is not untenable that in a direction to that herein indicated will be found the most marked progress that is to be made during the next decade in the joint use of the steam engine and dynamo.

WANTED, A NAME.

If the origin of the term "underwriter," in an insurance sense, be accepted as precedent for the coining of analagus designations, the electrical fraternity would long since have become known in the commercial world as "under-bidders," or even as "profit-sharers" from its chronic characteristic of always underbidding the other fellow, or its ruthless sacrifices in their insane race for business. The fiercenes of competition in the electrical supply line, as well, in fact, as in all other lines of the electrical industry, is perhaps unappoached in any other branch of trade and so cut up is the business in some channels that it might tend to bring the participants to their senses if they could become to be known as a class referred to only in terms of ridicule.

But as to the origin of the term "underwriter," which is suggestive, Mr. Edward Niles, in a paper on "Special Agents" read before the last annual meeting of the Fire Underwriters' Association of the Pacific, pointed out that the name "underwriter" dates back to the first part of the present century. Up to 1824 insurance companies were not allowed to effect marine insurance, with the exception of the London and the Royal Exchange. The high rates charged by these two companies, which had the monopoly, forced the business into the hands of private persons, who were obliged to resort to a trick, in order to transact their business. These persons could not enter into an agreement jointly as a company, as such a proceeding would be illegal. So they met in Lloyd's coffee house in London, and when a merchant or ship-owner wished to insure his vessel or freight, these individuals subscribed or "wrote under" the policy of inurance the sum each would make himself liable for, in case the ship or cargo was lost.

Surely the conditions under which the marine insurance man of seventy odd years ago labored were hardly more onerous than those confronting the electrical salesman of to-day and as the familiar name of underwriter is now a commonplace, so may the future recognize by an equal familiarity some of the difficulties under which the toilers of the present labor.

PREACHING THE GOSPEL OF PROSPERITY.

"The American Economist" of March 25th presents in the form of a pictorial supplement an unique and interesting array of drawings and cartoons selected from the files of that paper for the past three yeas. The illustrations, several hundred in number, emphasize in a peculiarly forcible manner the strength of the doctrine of Protection as an active, living political issue, and also demonstrate with what vigor and aggressiveness this dotrine has been expounded by the American Protective Tariff League.

Literature.

Any Book Published Mailed upon Receipt of Price by The Journal of Electricity.

"A Pocket Dictionary of Electrical Words, Terms and Phrases," by Edwin J. Houston, Ph. D. Flexible binding, gilt edges, 945 pages, 3 1-2x6 1-4 inches. Published by The American Technical Book Company, 45 Vesey street, New York. Price: Leather, $3.00; Cloth, $2.50.

Any publication under the authorship of either Edwin J. Houston or of Messrs. Houston & Kennelly, bears the indelible imprint of originality, thoroughness and accuracy, and so universally is this fact recognized that to thousands of electrical readers the mere announcement of a new book under their authorship, either single or collectively, awakens the knowledge that that book is indispensible to every electrician, whether he be student, theorist or practitioner. Such, in brief, is the character of Houston's "Pocket Dictionary of Words, Terms and Phrases."

In the preparation of the supplementary matter for the fourth edition of "Houston's Dictionary of Words, Terms and Phrases," it was found that so rapid had been the growth of the art and its terminology, that the number of new words, terms and phrases greatly exceeded those in the original dictionary with its appendix. It was, therefore, necessary to collate the old material with the new and arange it alphabetically in order to avoid the incongruity which would exist in a second appendix which would outnumber the definitions in the last edition of the book. The necessity for economy in space led to the adoption of concise definitions, to the exclusion of all encyclopedic matter.

It is evident that, in the light of former experience gained from the preceding editions of the dictionary, the author decided to employ no cross-references in the Pocket Dictionary, and, therefore, to arrange the terms alphabetically in their natural order. There has thus

been produced an epitomized edition of the original work, together with the new matter that has been added thereto. The Pocket Dictionary is therefore the separate publication of the fourth edition with its supplemental matter, in a convenient form for those who seek only brief definitions. All technical students, however, and those who wish to penetrate deeper into the science, will find it greatly to their advantage to obtain a copy of the complete fourth edition, the encyclopedic matter in which, with its system of cross-references, will enable them to gain material advantages.

A striking evidence of the certainly phenomenal advance that has been made in electrical applications during the last few years must be noted in the fact that the Pocket Dictionary contains over 6,000 new electrical words, terms and phrases that have come into use since 1894, the book containing definitions of about 1,000 different words and of about 15,000 different terms and phrases.

"The American Newspaper Annual." Published by N. W. Ayer & Son, Times building, Philadelphia. Cloth, 1054 pages, 6x9½ inches. Price, $5.00.

The science of advertising in periodicals has become a most exact one to those who have devoted years to its study, and of these, Messrs. N. W. Ayer & Son, and George P. Rowell & Company are perhaps the foremost in this country. Both of these concerns issue newspaper directories, and that of Messrs. Ayer & Son for 1898 is at hand.

The American Newspaper Annual for 1898 is, as its name indicates, a cyclopaedia of American journalism. In detail, it is a carefully prepared list of newspapers and periodicals published in the United States, Territories, and Dominion of Canada, with valuable information regarding their circulation, issue, date of establishment, political or other distinctive features, names of editors and publishers, and street addresses in cities of fifty thousand inhabitants and upward, together with the population of the counties and places in which the papers are published. It also contains a description of every place in the United States and Canada in which a newspaper is published, including railroad, telegraph, express and banking facilities, as well as the vote of States and counties at the Presidential election of 1896.

It is obvious that the labor attending the publication of a work of this class forms an item of great expense, necessitating a selling price that may seem excessive, but which the careful advertiser soon finds is not so. The Annual lists over 22,000 periodicals, and it is safe to say that probably less than one quarter of the newspaper advertisers in America have occasion to consult a newspaper directory for information concerning publications in practically all portions of the continent, which leads to the suggestion that it might be profitable (it certainly would be convenient to a majority of advertisers) to publish in addition to the Annual in its present form smaller editions of it that shall contain information by States, or even by sections of the country. The Californian, whether he be manufacturer or merchant, finds no profit in advertising in Eastern publications, hence he has no use for, and may not care to buy, a great book containing a mass of matter, but four-fifths of which pertains to his own section and is of interest. With the Eastern manufacturer whose goods reach every portion of the country and who advertises in papers in almost every town and city, the case is a different one, and the Annual in its present most comprehensive form is at once indispensible and of priceless value. But doubtless the publication of lower priced editions of the Annual for the different sections of the country, such as a New England edition, a Southern edition, a Middle States edition, a Mississippi Valley edition, a Pacific Coast edition and a Canadian edition, would be a duly appreciated convenience by the great majority of advertisers the country over.

A "Manual of Static Electricity in X-Ray and Therapeutic Uses," by S. H. Monell, M. D.; published by William Beverly Harison, New York City. Second edition, with appendix; royal octavo, 622 pages and 18 pages index; 21 illustrations; printed on heavy paper, large type. For sale in San Francisco by the "Emporium," price $6.00.

This is by no means an easy book about which to express an opinion for the reason that it has at the same time both many good and many bad features; it is to be commended and condemned. It is an easy task to express unqualified disapproval, but not such an easy task to moderate the condemnation to suit the good qualitiese that may be weeded out of the trash.

The book is divided into two parts; part first contains XL chapters, the contents of which are as follows: I, The Holtz Apparatus; II, Collected Opinions as to the Value of Static Electricity in Medicine; III, The Care of the Holtz Machine; IV, Therapeutic Mtheods; V, Platform Methods in General; VI, How to Regulate the Strength of a Static Application; VII, X-Ray Apparatus and Static Methods; VIII, X-Ray Apparatus and Crook's Tubes; IX, The Three Best Methods of operating Static Tubes with Large Holtz Machine; X, X-Ray Photography; XI, X-Ray Effects in General; XII, Electro-Physiology; XIII, The Therapeutics of Static Electricity; XIV, Rheumatic Diseases; XV, Chronic Gout and the Uric Acid Diathesis; XVI, Neuralgias and Neuritis; XVII, Neurasthenias; XVIII, Chronic Functional Nervous Diseases; XIX, Static Electricity in Hysteria; XX, Pain; XXI, Brain Fag and Insomnia; XXII, Remarks upon some of the Mistaken Ideas of Beginners, which Experience and Information Corrects; XXIII, Miscellaneous Conditions; XXIV, Heart Disease, Chronic Grief, and Weather Neuroses; XXV, The Value of Electro-Muscular and Nerve Stimulation in Training for Contests of Skill, Strength, Speed, Endurance, and Dexterity; XXVI, Headaches; XXVII, Special Therapeutic Effects; XXVIII, diseases of the

Skin; XXIX, Ditto; Continued; XXX, Chronic or Sub-Acute Inflammatory Conditions within the Thorax; XXXI, Morbid Mental States; XXXII, Chronic Cathexias; XXXIII, Tonic Effects in Various Conditions; XXXIV, Impaired Voice of Singers—Debilities of the Aged; XXXV, The Contra-Indications of Static Electricity; XXXVI, Paralytic Diseases; XXXVII Writers Cramp; XXXVIII, Miscellaneous Conditions; XXXIX, Ditto; XL, Static Electricity in Gynecology;

Part Two; I, Historical Therapeutics; II, General Remarks, Relating to Medical Electricity, by T. Cavallo, F. R. S., 1777; III, Clinical Cases treated by Static Electricity, 1776-77 and 1795; IV, Sundry Clinical Observations; V, The Past and Present Nature of Electricity the Same; VI, Improvements in Electrical Apparatus in 1789; VII, The Celebrated Guy's Hospital Reports; VIII, value of Static Electricity as a Remedial Agent in the treatment of Disease, by Golding Bird, M. D., A. M., F. R. S., etc.; IX, Continuation of Dr. Bird's Report; X, Continuation of Dr. Bird's Report; XI, The Guy's Hospital Reports of Hughes and Gull; XII, Continuation of Reports of Sir William Gull, M. D., D. C. L., F. R. S.; XIII, Ditto; XIV, Ditto; XV, Cases Treated by Dr. A. Arthuis, of Paris, in 1872-73; XVI, Ditto; XVII, The Moral Effect of the Static Machine, Considered as a Medical Apparatus.

A careful examination of the above chapter list will disclose the fact that there is a good deal of repetition and a large amount of matter that is not essential to the subject in question; the classification is bad; in fact, there is almost no classification at all and the same subject is often treated of in a dozen different places through the book. Some of the actual directions to those who are ignorant of the methods of handling an influence machine (generally and improperly called a "static machine") or of treating a patient by the high tension currents and static electrification for which it is intended, are excellent. The explanations and directions in these passages are clear, concise, intelligable and to the point; the illustrations, which are intended to elucidate the text, are far from what could be desired in many instances.

We certainly expected great things of this text book, hoping that it might be a radical improvement on the usual type of Medical text-book on things electrical; unfortunately this is not the case. The same old absurd jargon is found throughout the pages of the work under consideration, and the same utter absence of a technical knowledge is displayed, though the author employs a diction that would lead one to imagine he really thought his utterances were ex-cathedral. On almost every page of the book can be found the expression "static current;" will some one kindly give a definition of the phrase? What, in the name of the good English tongue is a "static current?" If memory serves and dictionaries do not lie; if all the men who have worked in electricity and written standard books on the subject—for instance such men as Faraday, Maxwell, Kelvin, Thimpson, Guillemin, et al., have not been grossly deceived or have not grossly fooled the world at large, the words "static" and "current" are diametrically opposed in their meaning; static, as the word signifies, is used to indicate a condition of electrification in which electricity is regarded as at rest, simply under strain, while kinetic electricity is the term used to include all forms of current phenomena. To speak of a "static current," then, is about as absurd as to call a locomotive a stationary engine! And yet this unfortunate expression has found its way into every text-book on electro-therapeutics that deals with the subject of influence machines or their phenomena, and will probably continue to appear for years to come.

Dr. Monell makes many statements that the unwary reader will be too apt to regard as accepted truths, simply from the manner in which they are stated; he evidently is one of the many people who can not tell the difference between what they know and what they only think they know. For instance, he makes the statement in the most positive terms that the oscillating currents developed by the disruptive discharge of an insulated and charged patient, or what he calls the "static spark," penetrate deeply into the tissues. This may be true, but he gives no proof of the fact and seems to accept it as axiomatic; if this should prove to be the case it will be a quite anomalous phenomenon, for we know that the higher the rateofperiodisity, the greater is the skin resistance—the less is the penetration of the current into the substance of the conductor. Another error, or expression of ignorance, may be found on page 70. The author here states that it "is a law in electrics that the potential inside a conductor has the same value as at any point on its surface." We would respectfully call the doctor's attention to another "law in electrics," to wit, that a charge always resides on the surface of a charged, insulated conductor, and would suggest the careful perusal of "Elementary Lessons in Electricity and Magnetism" by Sylvanus P. Thompson; or if his digestion will stand the richer food, Maxwell's Treatise on Electricity and Magnetism, a classic that is one of the world's greatest books.

From page 114 we quote the following: "Moreover, none of the alleged injurious effects of x-rays, reported hastily and with more or less sensation, are caused by the static current." We should like to call the doctor's attention to a letter from Elihu Thomson in "The Electrical Engineer," January 6, 1897, in which the above quotation from the work under discussion was answered before it was written! To enumerate more of the errors of ignorance which dot the pages of this book, would be too much of a task; suffice it that from an electrical standpoint the statements made by the author are in many instances utterly without foundation and absurd.

Another fault to be found with the work, is the general tone of much that is said in regard to the work of others; the conceit of a man who can write a book of over six hundred pages, mostly given up to the statement that he is the only man who knows it all, and that if the poor practitioner wants to learn how to use "static cur-

rents" he must come to "My School," this amount of conceit, we fancy can better be imagined than described!

If the book were edited by someone with a tehnical knowledge of electricity, condensed to about two hundred pages, and much of the conceit eliminated from it, it would be an excellent text-book, for it certainly does contain some matter that may be of value to one in search of information in regard to the clinical necessities in the use of an influence machine. The collected cases and the clear method of describing the treatment in each case, are features to be highly commended. As this is about the only text-book giving any data in regard to the influence machine, it will be found of value to users of that form of electrical apparatus.

Philip Mills Jones, M. D.

Illumination

ELECTRIC POWER WITH LIGHTING AS AN ADJUNCT.

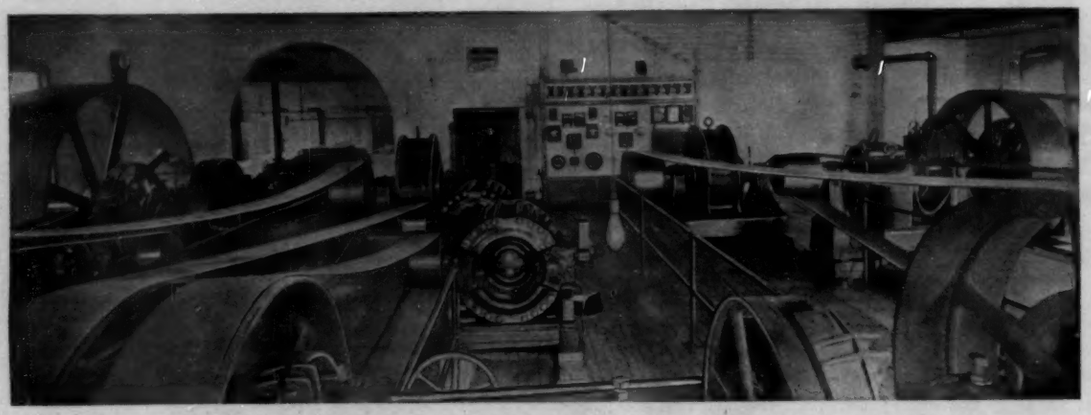
A GREAT number of central stations are now using that modification of the single phase system, known as the monocyclic system, by which current may be supplied to both lamps and motors at the same time from their alternating generators. This system was introduced at a time when the question of extending the area of operation began to force itself upon the attention of central station managers using either the single phase alternating or the direct current system of supply. With the first named the question of distance presented no difficulty, but motors could not be operated successfully by it; with the direct current system, while the motors presented no difficulty, the area of operation was limited. With the newer system it was found that both arc and incandescent lamps, as well as induction motors could be supplied from the same alternator, the first named operating directly from the ordinary two wire single phase circuits, the motors merely requiring a third wire to give a displaced voltage. Opeation of the monocyclic system has evidently proved satisfactory, as the installation about to be described, and which is but one of many, demonstrates.

One of the interesting examples of the introduction of the monocyclic system into a direct current station, allowing the area of its operaion to take a wide extension, exists at Middletown, Ohio, where Mr. E. F. McKnight, the President and General Manager of the Middletown Electric Light and Power Company has recently found it necessary to increase the monocyclic capacity of his plant to meet the increased call upon his station. In addition to the arc and incandescent lighting usual in towns of the size of Middletown, certain factories under progressive managers have adopted electricity in place of steam and the motor load on the station already far exceeds the lighting load.

The station fronts on the Miami and Erie Canal, having the tracks of the M. & C. Railroad immediately behind it. It is 65 feet wide and 115 feet long. Steam is supplied from two boilers, to one 450 compound condensing engine, and one 300 h. p. condensing engine. The generating plant consists of two General Electric 12-pole, 150-kilowatt, 1040-volt, 600-revolution monocyclic generators excited by two 1 1-2 kw. exciters; three 50-light Thomson-Houston series are dynamos and one G. E. 100 horse power 500-volt direct current generator, all driven from countershafting furnished with the necessary friction clutches.

The 500 volt machine is used exclusively to furnish direct current to several small motor plants throughout the city; the arc machines operate 112 city arc lamps.

The motor load on the monocyclic machines runs up to within a short limit of their capacity. The factory of the Miami Cycle and Manufacturing Co., a little over a mile away from the station, takes 200 horse power when its motors are running at their rated capacity, and considerably in excess of this under usual working conditions. This company manufactures the well-known Raycle, and 1200 o these wheels are built weekly, giving employment to 600 hands. The current is received in the factory in six 40 h. p., one 20 h. p. and two 10 h. p. transformers, reducing the pressure to 115 volts. The motor circuits run from the 40 h. p. transformers, the lighting circuits from the three of smaller capacity, and all the current is measured in a recording wattmeter, connected on the primary circuit. The motor equipment consists in all of ten General Electric induction motors, 3 of 20 h. p. in the machine shop driving 88 machines, one of 10 h. p. in the drill and pattern room driving 29 machines, another of 10 h. p.

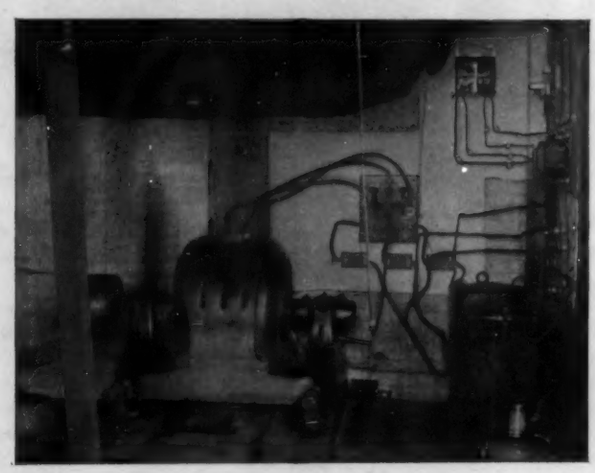


INTERIOR OF THE MIDDLETOWN, O., STATION.

driving the machinery in the frame department, three of 30 h. p. in the polishing room—two for the polishers

MOTOR NO. 1 IN THE FACTORY OF THE P. J. SORG COMPANY.

and one for the 48 inch exhaust fan; one of 5 h. p. driving two plating dynamos in the plating room, and an-



MOTOR NO. 2 IN THE FACTORY OF THE P. J. SORG COMPANY.

other of similar capacity operating a number of small machines in the assembling room, as well as a three ton elevator. The incandescent lights in the factory number 750, of which during the rush season almost all are lighted.

In addition to the Cycle Factory, Mr. McKnight furnishes power to the tobacco factory of the P. J. Sorg Company, in which two departments are already equipped, each with a G. E. 30 horse power induction motor. The first motor is the smoking tobacco department, on the first floor, and is bolted to shafting operating on the three floors above, 3 Caldwell pickers, 1 cutter, 2 granulators and 2 dust machines. Motor No. 2 is on the sixth floor, and is shown with the transformer and the meter, to which the primaries from the station are connected. From this point secondaries are carried to Motor No. 1 in the smoking tobacco department distant about 500 feet, and the lights in the different departments being tapped off before the motor is reached. Motor No. 2 drives two 7 1-2 inch rotary fans, used to dry all the tobacco, and also operates a five-ton elevator. The capacity of the drying department is 100,000 pounds of tobacco daily.

The benefits of electric drive by induction motors are, perhaps, nowhere so forcibly demonstrated as in these two installations. In the cycle factory the constant speed of the machinery, the absence of vibration and the power of the motors to respond to calls reaching as high as fifty per cent over their rated capacity, have enabled the manufacturers to give to every part of their wheels a perfect finish, as well as to greatly increase the output. In the tobacco factory the steady rate at which the tobacco passes through the dryers gives it a uniform cure. Previously the speed being variable, the tobacco would dry in spots only, and a second handling was almost always necessary. According to the foreman, the motor "saves him lots of time."

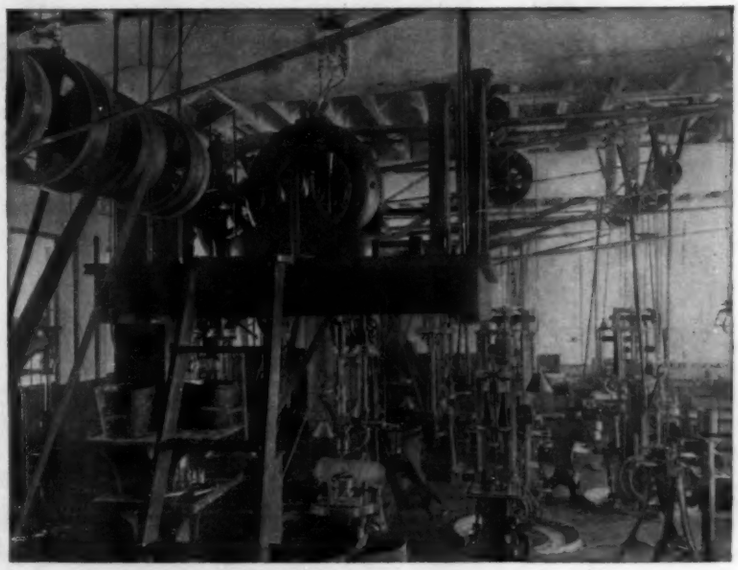
The incandescent lights in the town already wired number 3800; of these 750 are in the cycle factory, 100 are in the tobacco factory; 650 are in the opera house and 2300 in other parts of the town. These lamps burn with absolutely no interference from change in the motor load; in fact, the entire motor load may be thrown on or off without in the least affecting the burning of the lamps, the presence of the motor load being usually determined by reference to the ammeter. The monocyclic machines operate with almost perfect regulation, requiring little or no attention to maintain the constant potential at all times.

Personal

Mr. Zentaro Iijima, the Tokyo representative of the Wagner Electric Manufacturing Company, was a recent visitor to San Francisco.

Mr. Theo. Hoffman, general manager of the Hawaiian Electric Company, was in San Francisco recently purchasing additional station apparatus. He is visiting Eastern cities before returning to Honolulu.

Mr. E. C. Jones, chief engineer of the San Francisco Gas and



DRILL ROOM, MIAMI CYCLE & MFG. CO.

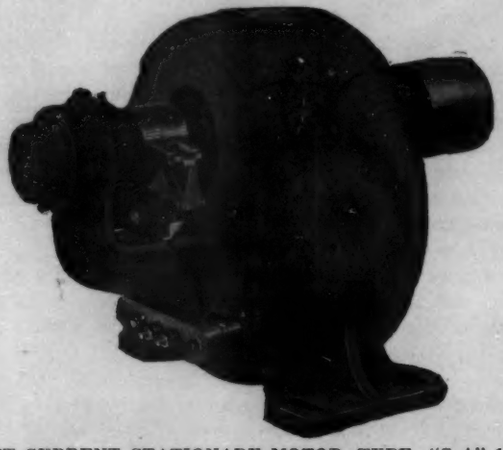
Electric Company, is spending the month at Coronado, Cal., in quest of rest and recreation.

Dr. Thomas Addison, Manager for the Pacific Coast District of the General Electric Company, is in New York and will not return to San Francisco before May 1st.

Prof. A. Van der Naillen and wife have gone to Europe where six months or more will be spent in touring through England, France, Belgium and Italy. The features of the various electrical engineering schools of these countries will be closely studied by the Professor with the view of improving, if possible, the electrical department of the Van der Naillen School of Engineering.

Mr. H. H. Sinclair, vice president and general manager of the Southern California Power Company, returned from the East on the 19th inst., after having succeeded fully in financing the affairs of the Southern California Power Company. Work on the 80-mile, 33,000-volt installation is progressing rapidly and without doubt the company will be able to deliver power in Los Angeles during September next.

Mr. I. Fujioka, Instructor of Electrical Engineering of the Imperial University of Japan and Consulting Engineer for the Tokyo Electric Light Company, has been granted a two years'



DIRECT CURRENT STATIONARY MOTOR—TYPE "C A" 1 H. P.

leave of absence from home and is now making a tour of the world for the purpose of personally studying the most recent advances in electrical applications. Mr. Fujioka is one of the best informed electrical engineers in Japan.

Dr. F. A. C. Perrine has been appointed consulting electrical engineer of the newly organized Standard Electric Company of California for the proposed electric power transmission from Blue Lakes City to San Francisco, in consequence of which he has applied for a two years' leave of absence from the active work of the chair of professor of electrical engineering of the Leland Stanford, Junior, University. No more worthy appointment could have been made and news of it will be received the country over with the satisfaction of the knowledge that in Dr. Perrine's selection the transmission company has secured the services of one of the best electrical engineers to be found in the American profession.

Mr. Clement A. Copeland, of Los Angeles, has been appointed Assistant Professor of Electrical Engineering of the Leland Stanford Junior University and will, during Dr. Perrine's leave of absence, take charge of the work of the department under the general direction of Dr. Perrine. Mr. Copeland entered with the "Pioneer Class" of Stanford from San Diego, making electrical engineering his major subject. This department at that time not being fully developed, on the advice of his professors he went to Cornell University, where he graduated with the class of 1896 in electrical engineering, since which time he has been engaged in electrical work. He stands very high as a practical electrician, and has in addition a thorough knowledge of electrical theory and mathematical physics.

Industrial

In Responding to Advertisements in this Publication, please mention "The Journal of Electricity."

A NEW LINE OF SMALL MOTORS.

The General Electric Company announces in a recent bulletin a new line of well designed and thoroughly constructed direct current motors of small capacity adapted to the direct application of power to small

DIRECT CURRENT STATIONARY MOTOR—TYPE ⅛ H. P.

machines of all kinds. They have been given the designation of "Type C A" and in their design the production of an efficient motor, sufficiently light and compact to allow of installation in cases where space is limited and absolutely rigied support unobtainable has been kept constantly in view. A magnetic circuit, therefore, entirely of laminated iron has been adopted and greater lightness and compactness is thus secured than would have been possible with cast iron. Furthermore, by the use of laminated iron a uniform magnetic circuit is insured.

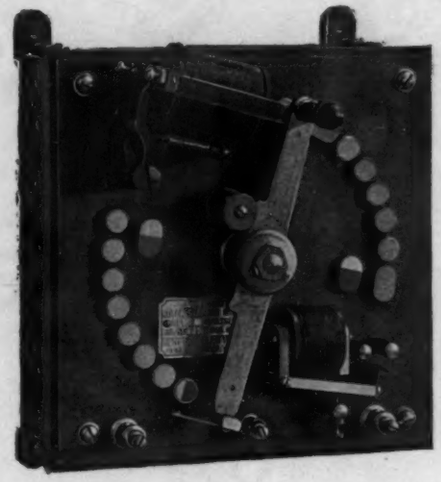
High grade material is used exclusively throughout these motors and

DIRECT CURRENT STATIONARY MOTOR—¾ H. P.

the workmanship is the best. The construction of the armature, commutator and field coils follows closely that in the standard General Electric railway motors. Indeed every feature of excellence of the latter has been retained in the "C A" type. The laminated armature core is toothed and wound with the Eickemeyer type of coil. The leads from the armature are soldered directly into slots in the

segments and the field coils are thoroughly taped and mounted on laminated pole pieces. The armature can be withdrawn after taking off the pulley end bearing, and the field coils removed through an opening in the frame. In the larger machines the shaft is mounted on two similar swivel bearings each self oiling. The brush holders are adjustable radially, and may be revolved around the commutator if required. The neutral point is very wide, however, and no adustment of the brush holder is necessary. These motors are enclosed and thoroughly protected from mechanical injury, but thorough ventilation is provided by holes in the bottom of the case and around the commutator end of the armature. Should these motors be used in places where flying dust necessitates extra protection, the commutator and brush holders may also be encased.

The speeds are lower than usual with motors of small capacity and better provision for overload is thus given and losses are not so great. The regulation, efficiency and disposition of the material in the "C A"



AUTOMATIC MOTOR STARTING RHEOSTAT.

motors also combine to give them a continued high economy. Heating tests show that they will run continuously with but slight increase in temperature, and even with a momentary overload of 100 per cent little or no sparking is noticeable. In cases where a number of these motors are required to meet special conditions, the standard construction and wiring is susceptible of modification.

No rails are necessary with this motor. The belt is tightened by moving the motor on the lag screws, which pass through elongated holes in the feet of the frame and hold the motor in place.

One feature of advantage which this motor has over others is the possibility of placing it in almost any position with no greater change than the turning of the bearings to suit the position selected. The "C A" motor may be installed on the floor or be suspended from the ceiling or be set on a shelf or attached to a wall. In every case the oil cellar is at the bottom of the bearing.

The 1 h. p. and ½ h. p. "C A" motors are designed for 115, 230 and 500 volt circuits, the ⅛ h. p. are 115 volt circuits. The floor space for the first named is only 22½ in. by 16 1-2 in. and for the 1-2 h. p. motor 18 3-4 in. by 13 in. The motors are finished in black with brush holders and small parts nickeled and polished.

For use with the two larger sizes a new type of rheostat has been developed. It is provided with an automatic switch which breaks the circuit in case of overload and effectually protects the motor armature. The smaller sizes are series wound and require no rheostat.

"The Journal of Electricity arrives in good order and it is a genuine pleasure to peruse its well-edited pages," writes Mr. J. H. Klieser, of Unga, Alaska.

NOVELTIES IN INCANDESCENT LAMPS.

The Brooks-Follis Electric Corporation is to be congratulated upon securing the order for the first installation of 220-volt lamps in San Francisco, namely, those to be used in the new and complete plant installed by W. R. Hearst in the new "Examiner" building, corner Market and Third streets.

The 220-volt type of incandescent lamps is made in voltages ranging from 200 to 250 volts. The 16 and 25 candle power lamp is 5½ inches long over all and the 32 candle lamp is 5⅝ inches long over all. The diameter of the 16 and 25 candle power lamps is 2½ inches and of the 32 candle lamp is 2⅞ inches.

Coiled and anchored filaments are used permitting the use of the lamp in any position without drooping and distortion of the filament. All lamps of this type are also furnished with a glass shield being mounted between the leading-in wires, preventing any possibility whatever of short-circuiting at this plant, which is a difficulty liable to occur when this precaution is not used. The Brooks-Follis Electric Corporation is prepared to fill orders for this type of lamp on short notice.

In this connection it may be well to call attention to the immense stock of lamps carried, it being probably the largest west of Chicago. At no time is this stock permitted to run below 50,000 lamps, if it can possibly be avoided, and it often runs up above 75,000 lamps. This feature places them in a remarkably good position to fill all orders with dispatch, which is quite a feature when quick delivery is imperative.

Attention is also called to the Fostoria Duplex Lamp, for which four claims are made:

First. That by the use of the incorporated switch, the candle power of the lamp can be doubled at will and turned back to normal candle power at the pleasure of the user.

Second. That if burned at ordinary candle power, using each filament separately, it will last twice as long again as any lamp now on the American market and from the excellent construction of the filament the globe will not blacken.

Third: That it can be used in all standard bases without any changes, expense or inconvenience.

Fourth: That, both price and efficiency considered, it is by far the most economical lamp yet brought out. The lamp has demonstrated its commercial value fully and they are selling remarkably fast. .....

WHAT IS "KIP?"

The catchy "Kip" advertisement appearing elsewhere in this issue is bound to excite both mystery and admiration in the mind of the reader,—mystermy as to what the "three new things indispensible to every electrician, every fixture house and every central station," can possibly be. The feeling of admiration experienced by the reader is due to the realization that the advertiser's art has devised a novelty that excites the curiosity and demands attention. If there is something new abroad in the land that is indispensible to electricians, fixture men and central stations, all become eager to know just what those "three new things" are. .....

It violates no confidence to state that these "three new things" are chemical preperations which are invaluable alike to central station men and to patrons of electric lighting companies. Furthermore, as the advertisement states, the names of these new chemical compounds are "Karsline," "Inline," and "Playtone." Just what they are, what they will do, and how to use them will be made clear on application by mail to the Pacific Electric Company, 120 Main street, La Crosse, Wis., whose tasty folder on the subject is filled with interest.

THE NEW "G. E." ENCLOSED ARC LAMP.

A modification of its enclosed arc lamp has recently been perfected by the General Electric Company, which, while preserving the essential features of its well known direct and alternating current lamps, with enclosed arcs, substitutes a flared porcelain reflector for the outer globe. The mechanism of the lamp is similar to that of the standard enclosed arc lamps, but the use of the reflector instead of the globe, allows a large amount of light, which, otherwise, would be absorbed in the outer globe, to be thrown down by the reflector and thus utilized. Calculating this absorption of light at from ten to thirty per cent, the single globe lamp allows of the utilization of just so much of the total light from the arc, as well as that which is reflected. In cases in which the direct light from the arc is not objectionable and a general diffusion of the light not absolutely desirable,

such as in cafes, hotels, restaurants, etc., the single globe is peculiarly adapted.

In designing the lower part of the frame, care has been taken to render it both light and delicate and yet sufficiently rigid to withstand ordinary usage, without interfering to any extent with the passage of the light or casting heavy shadows. It is highly nickled and thus, during the day time when the light is not needed, the ornamental appearance of the lamp is not detracted from. The inside of the porcelain shade is highly polished and gives a good reflecting surface. It is interchangeable and can be used with either direct or alternating globe enclosed arc lamps. By an arrangement of the lower rim of the cover of the mechanism, the reflector may be substituted for the outer globe of the double enclosed arc lamps. As in the direct current double globe lamps, a simple adjusting coil allows of the use of 5, 4½ or 4 amperes. By using a reflector instead of the globe a very satisfactory light may be obtained from this lamp with a current of only four amperes. A reactive coil in the alternating lamps, allows of adjustment for any line voltage between 100 and 120 volts and frequencies of 60and 125 cycles.

The economy in carbons is the same as that obtained in the double globe lamps, and in addition the lowering of an outer globe is done away with. The globe in which the arc is enclosed is protected by wire netting.

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The Westinghouse Electrictric and Manufacturing Company has just opened a new branch office at Austin, Texas. Mr. J. E. Johnson will have charge of the office and of the further extension of Westinghouse business in the Southwest. The large contracts which this Company has been handling in Mexico and the Texas region have led to the establishment of this new center of electrical trade.